(2)

US ARMY
LABORATORY COMMAND

AD-A232 750

CONTRACT REPORT NUMBER 6-91
PREPARED FOR THE

HUMAN ENGINEERING LABORATORY

BY

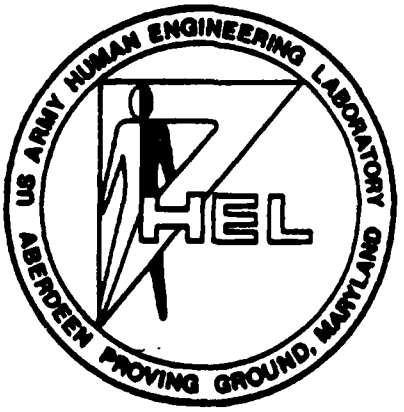
ASI SYSTEMS INTERNATIONAL
Aberdeen Group
211 West Bel Air Avenue
Aberdeen, MD 21001

PLS ENHANCEMENTS -
USER SURVEY RESULTS

FINAL DRAFT REPORT

Contract Number DAAD05-89-C-0071, Mod. 1

August 1990



ABERDEEN PROVING GROUND, MARYLAND 21005-5001

ASI 90-65

PLS ENHANCEMENTS - USER SURVEY RESULTS

Contract Number: DAAD05-89-C-0071, Mod. 1

FINAL DRAFT REPORT

August 1990

By:

D. J. Shearin, Sr.

Prepared for:

Combat Service Support Division
U.S. Army Human Engineering Laboratory
Aberdeen Proving Ground, Maryland 21005-5001

ASI SYSTEMS INTERNATIONAL
ABERDEEN GROUP
211 W. Bel Air Avenue, Aberdeen, MD 21001

13 August 1990

SUBJECT: Transmittal of Draft Copy of ASI Report 90-05, "PLS Enhancements - User Survey Results."

TO: Director
U.S. Army Laboratory Command
Human Engineering Laboratory
ATTN: SLCHE-CS (Mr. John J. Salser)
Aberdeen Proving Ground, MD 21005-5001

Dear Mr. Salser:

Reference is made to Contract Number DAAD05-89-C-0071, Mod 1. The referenced contract calls for the preparation of an illustrated briefing on above subject, presentation of the briefing to a designated list of user and developmental agencies, and conduct of a user interest survey as part of the briefing. These actions have been completed.

The Statement of Work also calls for documentation of the results of the user survey, by agency, and by item in a prioritized fashion, and inclusion of such information as part of a final Draft report of the Intermodal AMCON and HIK upon completion of the survey.

Accordingly, herewith is an initial draft report entitled, "PLS Enhancements - User Survey Results" (duplicate). Upon receipt of Government comments, a final report will be provided.

Sincerely,

Allan R. Burke, Director
Aberdeen Operations

ARB/djs

ASI 90-05

PLS ENHANCEMENTS - USER SURVEY RESULTS

Contract Number: DAAD05-89-C-0071, Mod. 1

FINAL DRAFT REPORT

July 1990

By:

D. J. Shearin, Sr.

The views, opinions and or findings contained in this report are those of the author and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other documentation.

Prepared for:

Combat Service Support Division
U.S. Army Human Engineering Laboratory
Aberdeen Proving Ground, Maryland 21005-5001

PREFACE

The work recorded in this report was authorized under Contract DAAD05-89-C-0071 Mod. 1, dated 15 March 1990. TRADOC organizations, including selected TRADOC Schools, were briefed on the results of experimental prototype testing of Phase II design Hook Lift Interface Kits (HIK) and Intermodal Ammunition Containers (AMCONS) and a series of additional concepts for further enhancements to the Palletized Loading System (PLS). Briefings were conducted during the period June-July 1990.

ACKNOWLEDGEMENTS

The author of this report wishes to express his sincere thanks and appreciation for the technical assistance provided by Mr. John J. Salser, the U.S. Government Principal Investigator who assisted the author in the conduct of the presentations and the user interest surveys. His thorough knowledge of the PLS and the PLS experimental hardware, as expressed during question and answer periods, was of inestimable value to the overall success of this undertaking.

TABLE OF CONTENTS

TABLES

FIGURES

INTRODUCTION

The U.S. Army has recently completed testing of three competing models of a 16 1/2 ton capacity cargo vehicle called the Palletized Loading System (PLS). The PLS has a unique capability to upload and download a loaded flatbed from the vehicle to the ground and from the ground to the vehicle by use of a hydraulic Load Handling System (LHS). The PLS is scheduled as a replacement vehicle for the 10 Ton HEMTT. The primary mission of the PLS is the resupply of ammunition.

Because of the versatility and unique capabilities of this vehicle, the Project Manager, Ammunition Logistics (PM AMMOLOG), supported by the U.S. Army Human Engineering Laboratories (HEL) has initiated a program under the title "PLS Enhancements". The objective of this program is to find ways to further extend the capabilities of PLS through the application of Kits and/or modifications to the basic system, with particular emphasis being placed on the soldier/equipment interfaces associated with each PLS enhancement item.

This report summarizes the results of the HEL/PM AMMOLOG effort and the results of a user survey conducted as part of a series of briefings presented to selected DoD, Army Materiel Command (AMC), and Training and Doctrine (TRADOC) organizations to obtain their reaction to the the prototype hardware developed to date, and concepts for future enhancements to further increase the overall capabilities of the PLS vehicle.

BACKGROUND

The U.S. Army Human Engineering Laboratory (HEL), and the Project Manager, Ammunition Logistics (PM AMMOLOG) recently completed a series of Proof of Principle (POP) type field trials on dynamic prototypes of two sub-systems which are intended to enhance the performance capabilities of the Palletized Loading System (PLS). The first of these is an Intermodal Ammunition Container (AMCON) which is intermodally compatible with the PLS and commercial wholesale/retail handling and transport equipment including commercial container transport vehicles, overhead gantry cranes, rail cars, and container ships. When loaded they can be stacked nine high in the cells of container ships, the ends

can be folded for easy retrograde, and when one end is folded outward, the AMCON can serve as a loading ramp to upload and transport light vehicles. The AMCON also offers other advantages over the current model of the PLS flat rack. It has been certified by the American Bureau of Ships (ABS) for intermodal transport.

In a related effort, fabrication of an aircraft compatible PLS flat rack has recently been completed which contains a series of pads underneath the floor which more evenly distributes the weight of the PLS flat rack and cargo to prevent damage to the floor of C130, C141 and C-5A type cargo aircraft. It is being tested by Natick Laboratories. If successful, this will provide a PLS flatrack which can be transported by military aircraft.

The second item is the Hooklift Interface Kit (HIK) which provides the PLS with the capability of uploading, transporting, and downloading any of the world's inventory of ANSI ISO 20 ft. commercial containers, as well as a number of military shelters with standard corner castings such as the DEPMED Shelter, without the use of the PLS flat rack. The primary advantage to carrying shelters/containers without the flat rack is that this method lowers the overall height of the vehicle carrying a container. It also enables the PLS to carry heavier cargo. (The increased cargo weight being equal to the weight of the flat rack which is not required.)

Proof of Principal has been firmly established for both prototype items which successfully met or exceeded all test objectives during recent field trials performed at the HEL Logistics Test Site, Aberdeen Proving Ground, MD. (See Reference 1 for the detailed results of these field trials).

As a follow-on, closely related effort, HEL is in the process of procuring prototypes of an additional PLS enhancement item for proof of principal type field trials called the Guide Roller Kit (GRK). The GRK will permit the transfer of loaded PLS flat racks and AMCONS from the M871 22 1/2 ton, and the M872 34 1/2 ton trailers to the PLS trucks in forward areas of the battlefield where overhead cranes may not be available. It can also assist in the uploading of empty PLS flat racks onto trailers for retrograde to rear areas. (Explanatory Note: The current ROC for the PLS requires the PLS flat rack to be transportable by the M871-872 type trailers.) This effort is in response to a query by the Commander AMC (Commander LOG Center at the time of inquiry) to find a way to offload fully loaded PLS flat racks from line haul trailers using the PLS. HEL is also in the process of contracting for a prototype PLS compatible container to be used for transport of water, POL, etc., by

the PLS. In addition to the above, PM AMMOLOG and HEL are examining a number of additional conceptual designs as possible follow-on enhancements to the PLS.

Figures 1 and 2 are photographs of the prototype models of the AMCON and HIK that have successfully undergone proof of principal type field trials. Figures 3 and 4 are sketches of the Guide Roller Kit.

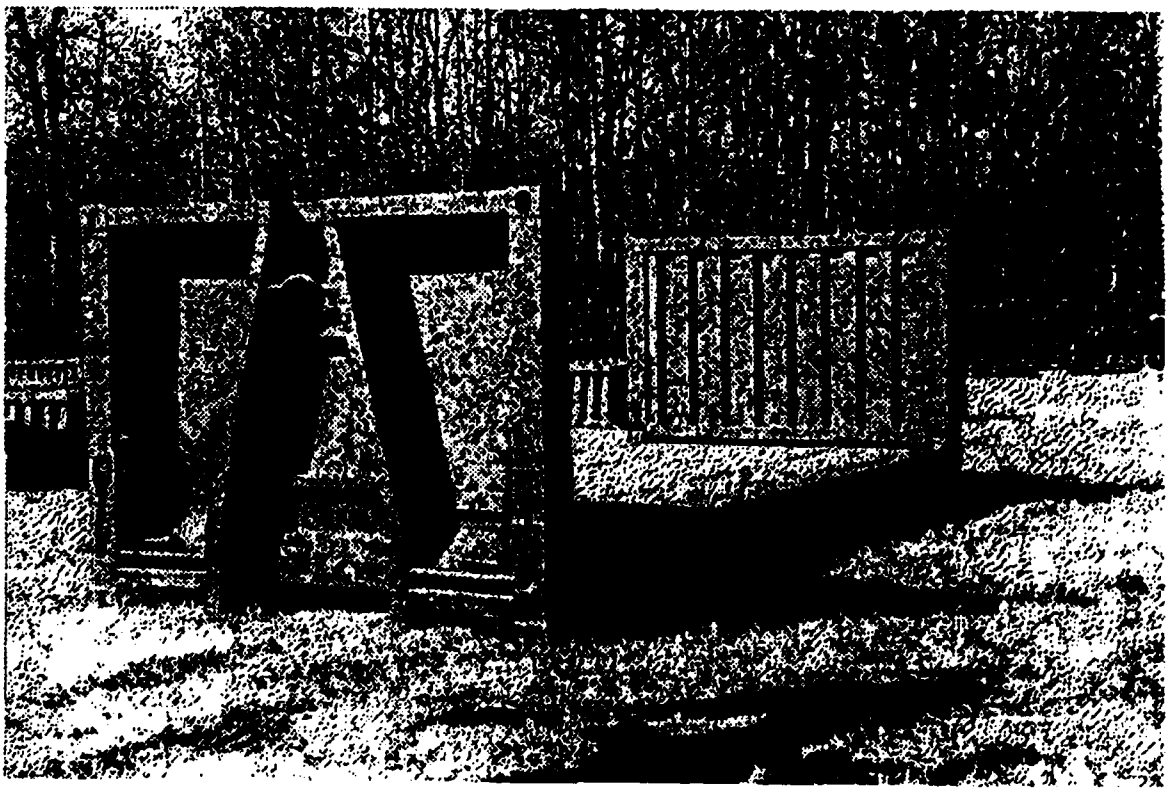


Figure 1. PLS Compatible Intermodal Ammunition Container (AMCON)

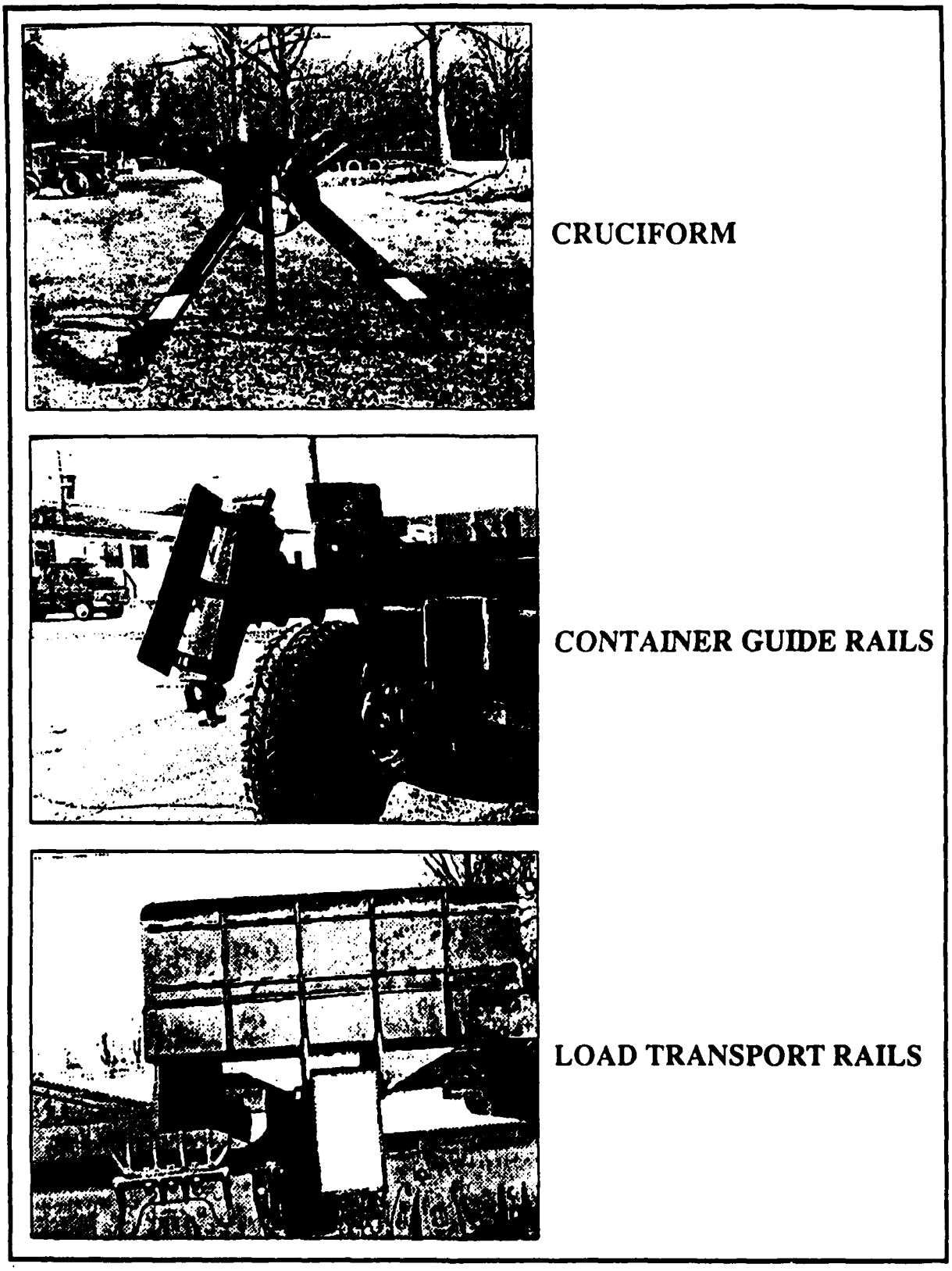


Figure 2. PLS Compatible Hooklift Interface Kit (HIK)

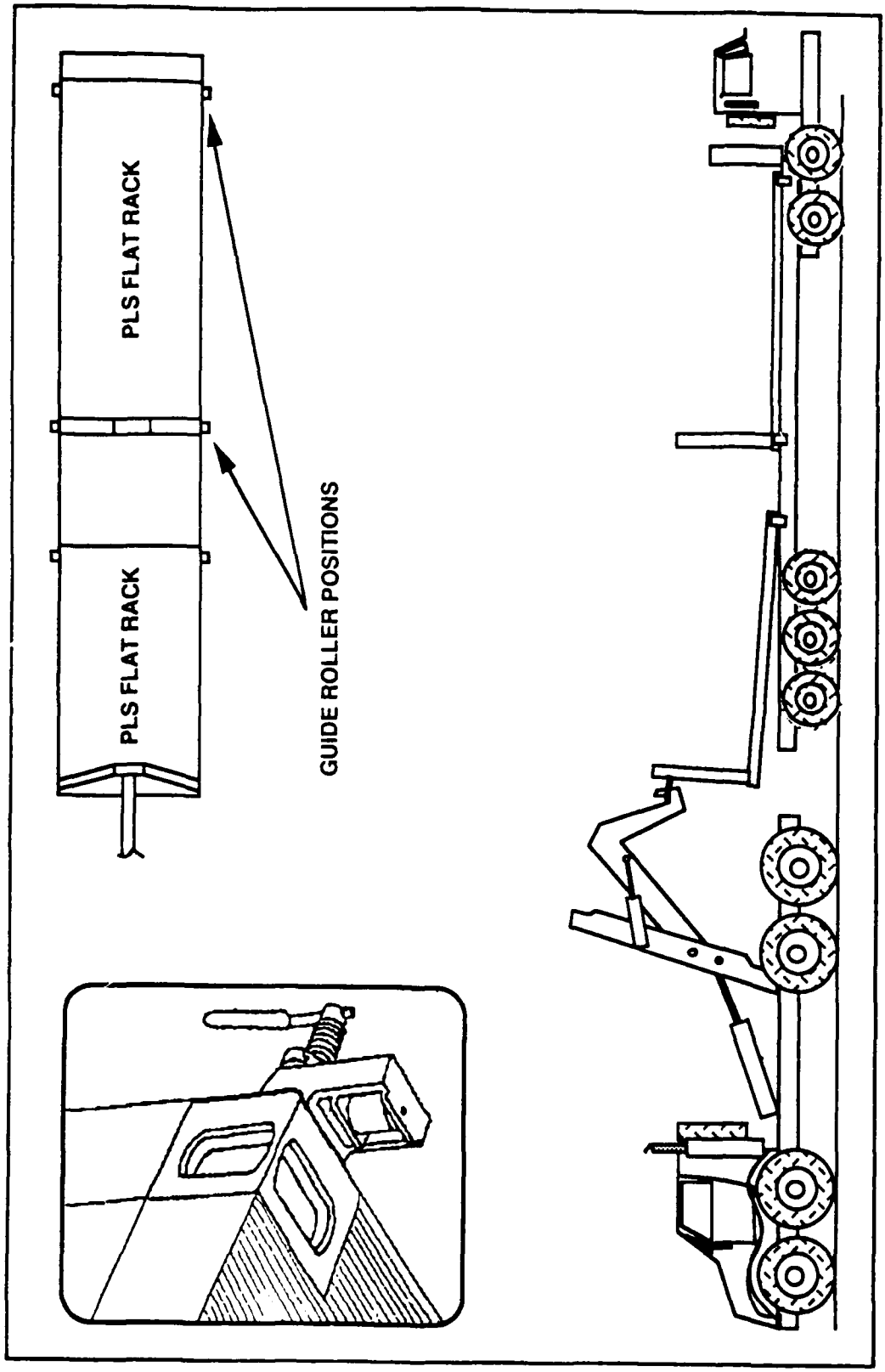


Figure 3. PLS Guide Roller Kit

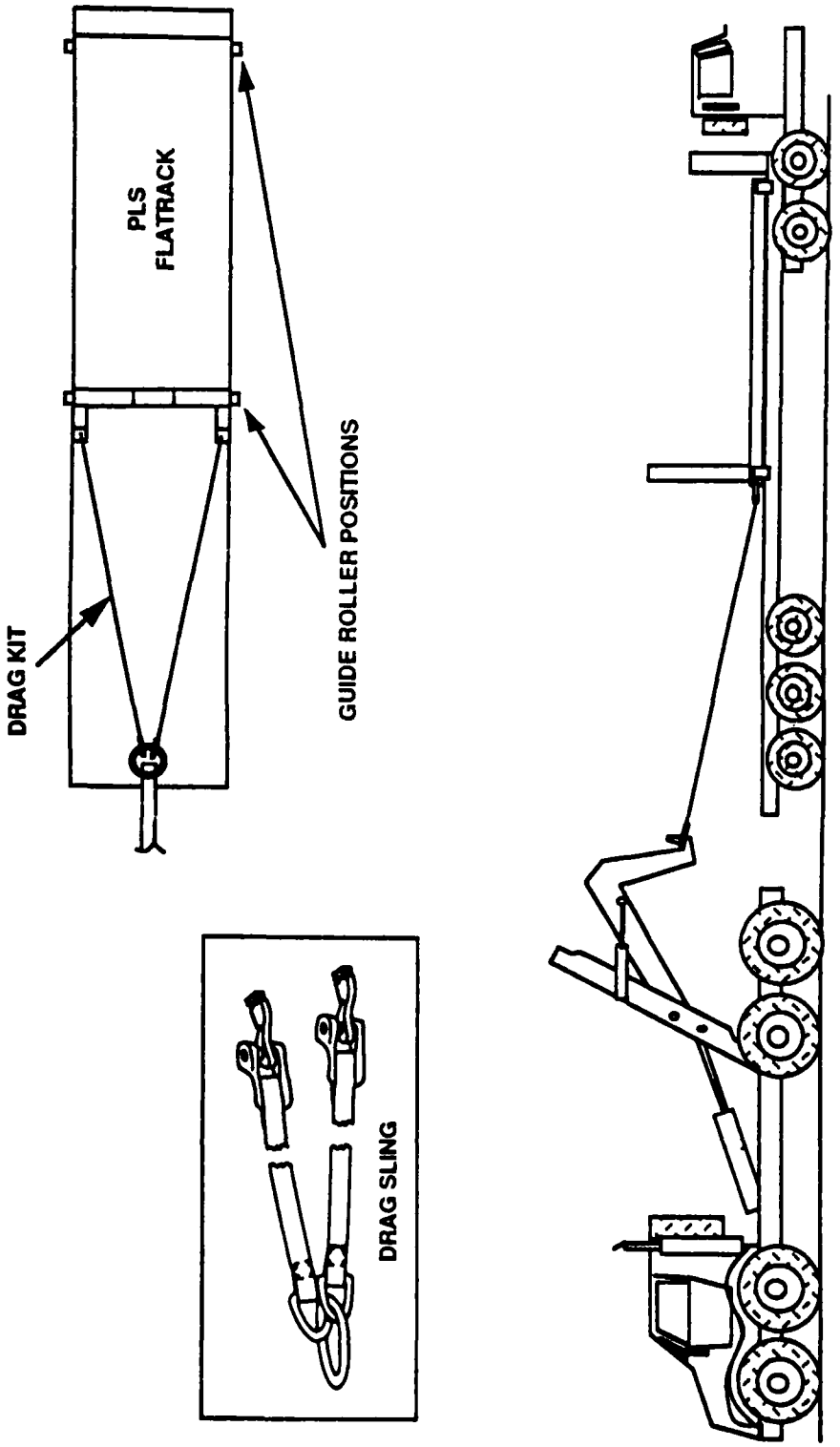


Figure 4. GRK Drag Sling Operation

PURPOSE

The purpose of this document is to present the results of a series of briefings presented to the user and developmental communities to provide the current status of PLS enhancement projects, to obtain an expression of their interests in PLS enhancements, and to document such interests with a user survey. (A copy of the Survey Form is at Appendix A.)

FUTURE CONCEPTUAL PLS ENHANCEMENTS

In addition to the three PLS enhancement items which have undergone field trials or will be tested shortly (the AMCON, HIK, and GRK) described in the Introduction to this report, the PM, AMMOLOG and HEL have completed designs of a number of near term conceptual items to provide additional enhancements to the PLS. These are briefly described in the following paragraphs

MLRS Lashing System

In many cases, the MLRS pods that are shipped to overseas locations arrive in damaged condition. This can generally be attributed to several causes; i.e., inadequate transportation container, tie-down procedures that make it difficult to remove the pods from the container, and difficulty in removing the pods with the fork lift. The PM AMMOLOG and HEL have obtained conceptual drawings of a MLRS lashing system that would be used to secure four MLRS pods to the AMCON or Open All container to prevent damage during intermodal shipping from CONUS to a theater of operations. Figure 5 is a sketch of such a lashing system. A prototype of this item can be available for proof of principal type testing within 3-6 months from award of contract.

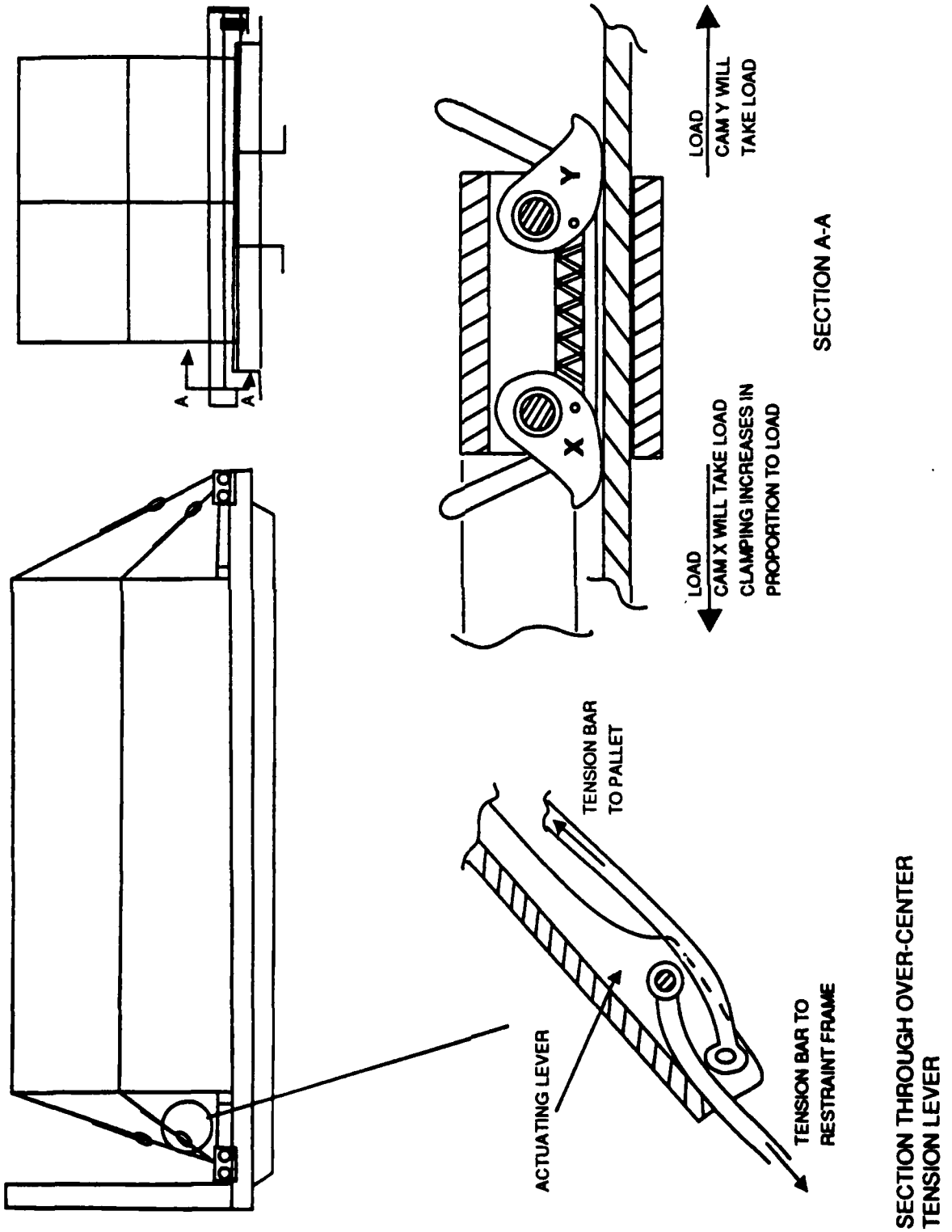


Figure 5 - MLRS Lashing System

Lightweight HIK

Although the Phase 2 design cruciform, a component of the Hooklift Interface Kit (HIK), resulted in a weight reduction from 1100 lbs to 800 lbs, HEL feels a further significant weight reduction in the cruciform may be possible for loading and transporting standard commercial 20 ft. containers and an even lighter HIK unit for the loading and transport of shelters which are significantly lighter in weight than the standard commercial ANSI ISO 20 foot containers.

Figure 6 is a sketch of a lightweight cruciform component of the HIK. It is envisioned that the lightweight cruciform could be used by medical units and communication units who may be issued PLS in the future for movement of medical and communication shelters that contain the standard corner castings.

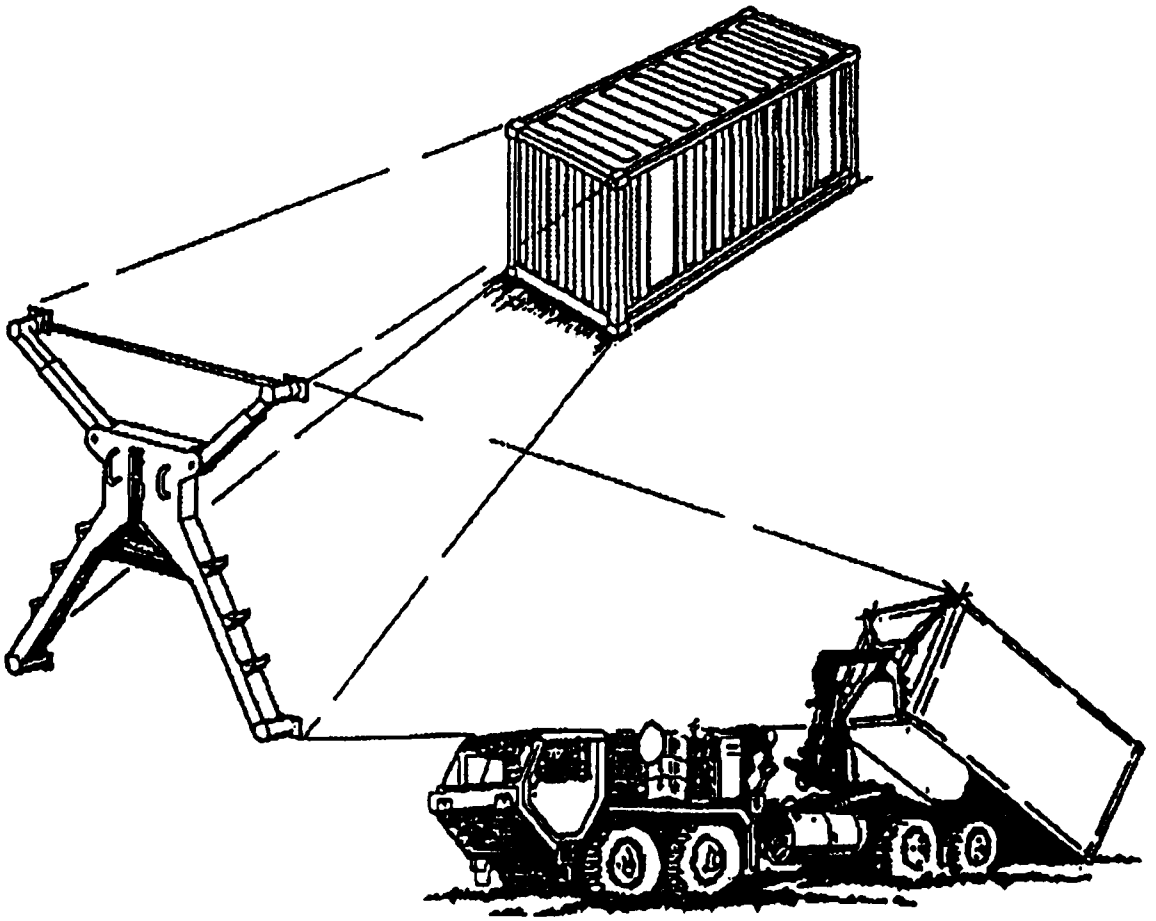


Figure 6. Lightweight Cruciform of the HIK

Emergency HIK

The HEL Project Officer, PLS Enhancements has also obtained a conceptual design for an ultra-lightweight cruciform component of the HIK that could be used for the emergency uploading and transport of a standard 20 ft commercial container or military shelter. The item could be issued to units with 20 ft shelters which could be then attached to the front of the shelter prior to movement. This would greatly decrease the amount of time required to move such a unit. This ultra-light cruciform could also be carried in the tool box of the PLS and could be used when a regular cruciform is not available for the uploading and transport of containers and shelters. A sketch of the Emergency Ultra-lightweight Cruciform is shown at Figure 7.

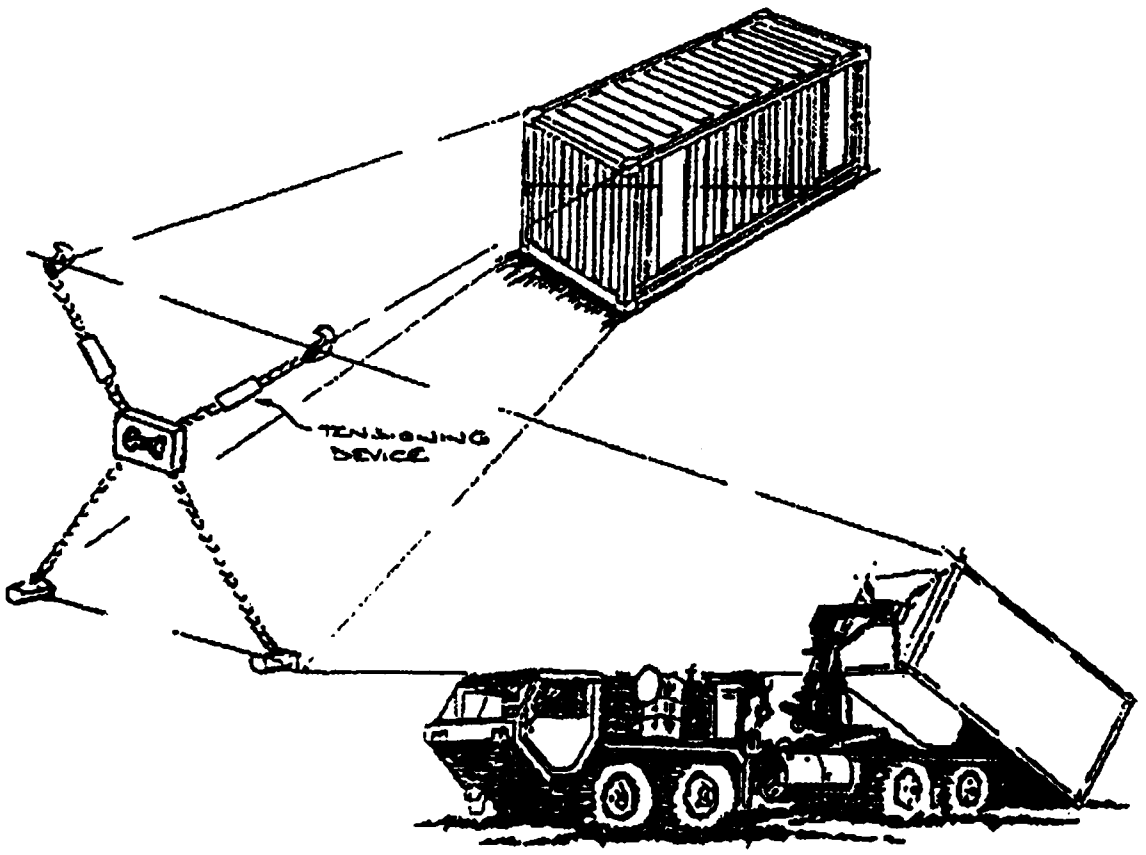


Figure 7. Emergency Ultra-lightweight Cruciform.

Open All Container

The Project Officer, PLS Enhancements, has obtained a special 8' x 8 1/2' x 20' container that, from external appearances, is the same as any standard ANSI ISO commercial intermodal container except for one unique difference. In less than a minute, the entire sides and top can slide open by lowering two slide rails, which are part of the end corner posts on which the sides and top rests. This exposes the entire 20 ft of cargo bed so that the contents can be rapidly unloaded by conventional fork lifts simultaneously from both sides of the container. It can also be configured as a maintenance van for repair of small engines/equipment; a shelter for the Quartermaster laundry, dry cleaning and decontamination unit; and an ordnance van for Class IX (repair parts), as well as many other applications. Prototype openall containers are presently undergoing testing by the German Army. Figure 8 is a photograph of this special container. The designer has advised HEL that the standard PLS bail bar used for picking up the PLS flat rack can be designed into the front end of the Open All container so that it can be uploaded and transported by the PLS without the use of the PLS flat rack or cruciform component of the HIK. (See sketch on lower half of Figure 8.)

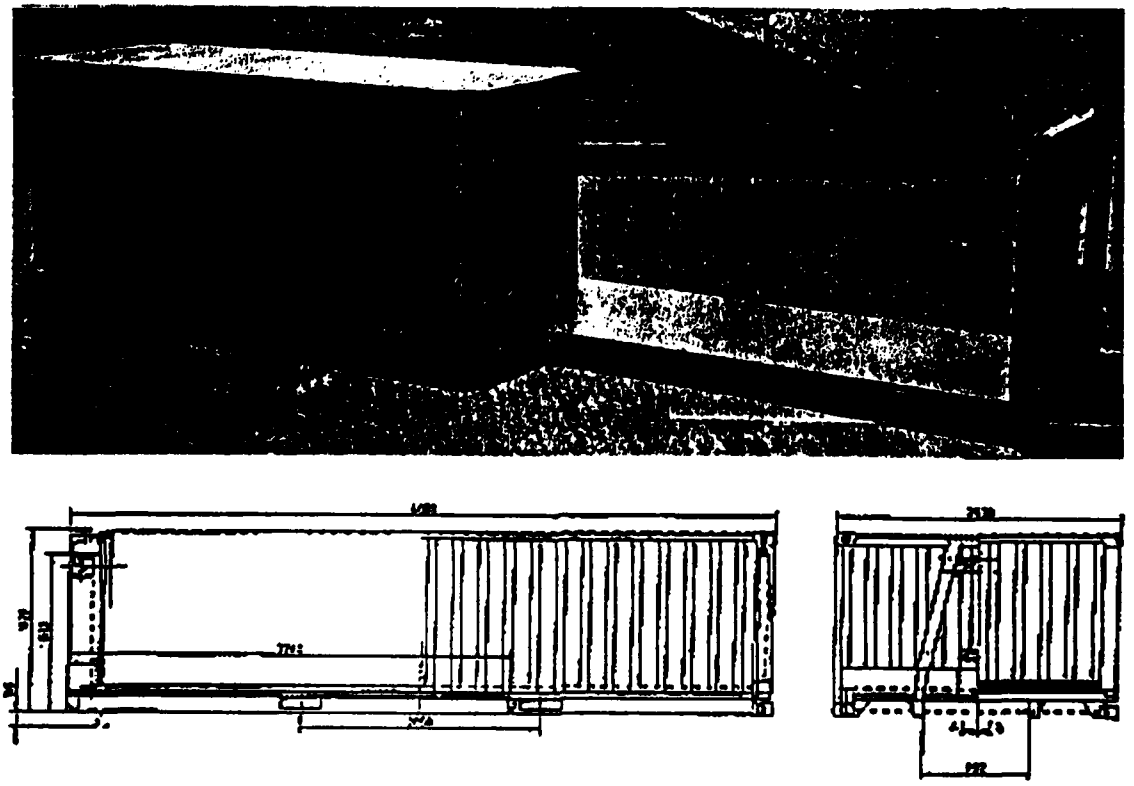


Figure 8. Open All Container

PLS Compatible HIK Semi-Trailer

The current PLS system is incapable of loading and transporting commercial 20 ft containers on PLS trailers. A conceptual design of a PLS compatible semi-trailer with a standard PLS Load Handling System (LHS) is available which would provide a capability for the PLS to transport two containers, one on the vehicle and one on the trailer. This item would double the current capability of the PLS to transport standard 20' ANSI ISO containers. A sketch of the PLS compatible HIK semi-trailer is shown at Figure 9.

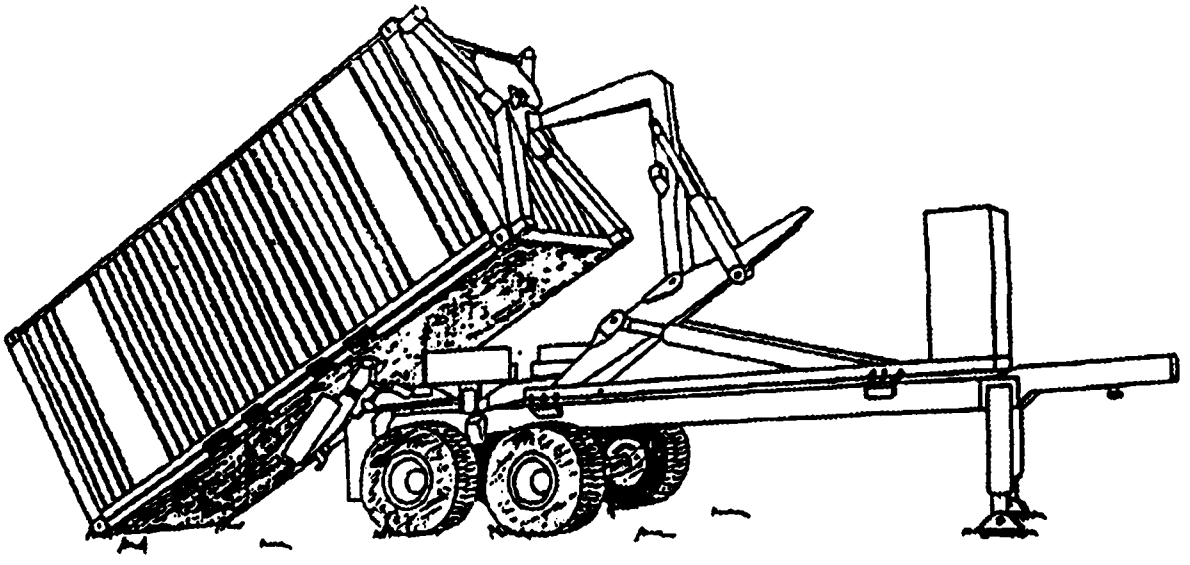


Figure 9. PLS Compatible HIK Semi-Trailer

Other Conceptual PLS Enhancement Items.

In addition to the above, the HEL PLS Enhancements Project Officer is looking at the soldier/equipment interfaces associated with the PLS to include a kit for offloading MLRS pods from a PLS flat rack in the forward areas of the battlefield with only the PLS vehicle, and the compatibility of the Advanced Cargo Aircraft (ACA) with PLS sub-systems.

As part of a joint effort between HEL and the Quartermaster School, the HEL PLS Enhancements Project Officer has also obtained approval to examine the transport of liquids, both POL and water, using the PLS vehicle. This liquid POL flat rack would provide the Army with a capability to transport 3000 or more gallons of POL or water to a remote location with the PLS. One scenario would be to offload the PLS flat rack onto the ground where unit vehicles could be refueled as the PLS vehicle returned to a POL supply point for another loaded POL flat rack. On his return to the unit, he would ground the loaded flat rack and pick up the empty flat rack as a "closed loop" type operation.

AGENCIES SURVEYED

Following is a list of agencies that were briefed on the PLS enhancements program and from whom completed survey forms were obtained: Attendance at these briefings was primarily from the combat development, training and doctrine organizational elements of user organizations and from the RDT&E elements of materiel development organizations.

Hq, TRADOC, Ft. Monroe, VA
Hq, Log. Center, Ft. Lee, VA
PM, Tactical Wheeled Vehicles, Heavy, Hq. TACOM, Warren, MI
QM Center & School, Ft. Lee, VA
Transportation & Aviation Logistics Schools, Ft. Eustis, VA
Belvoir RD & E Center, Ft. Belvoir, VA
Hq, DOD TRANSCOM, Scott Air Force Base, IL
Ordnance Missile & Munitions Center & School, Huntsville, AL

RESULTS OF SURVEY

The survey results are being presented in two categories. The first category includes the two items, HIK and AMCON, for which prototype hardware has been developed and Proof of Principal successfully established as a result of field trials. The second category is comprised of conceptual items. A prototype has been fabricated for one of the ten items. It has been named the "Open All Container", but has not been tested by the U.S. Army to date. Contract award for fabrication and demonstration of prototype items is pending on a second item, the "Guide Roller Kit". The remaining eight are in the concept design phase.

A total of 46 survey forms were obtained from the eight agencies listed above. Following is a summary of survey results based on an analysis of the completed forms.

1. Category "A" - Proof of Principal has been successfully established.

a. HIK - 98% of the personnel answering the survey question (45 out of 46) pertaining to the HIK agreed that the HIK had merit and development should be continued as a PLS Enhancement. One questionnaire contained the statement that "more information is required." A few of the questionnaires qualified the response by indicating that

continued development should be dependent on the decision as to whether or not the use of the PLS would be expanded beyond that of only an ammunition carrier which is to be used forward of the Corps Support Area. Other key comments of interest are as follows:

Training and Doctrine Community

- "The HIK may be a good item to have if the Army expands use of the PLS beyond use for ammunition transport."
- "Requirements/use needs to be [developed]/ evaluated.
- "The HIK has merit but it needs to be lighter."
- "The [HIK] system should be man handleable and meet road restrictions requirements. Requirements should be based on inter-intra theater requirements."
- "The HIK is essential to carry shelters on the PLS. It is the only apparent answer to the [excessive] height problem when trying to move containers loaded on a flat rack ."
- "The PLS must be able to interface with commercial containers."
- "The HIK development program should be continued. It can be used for movement of ISO type shelters [Current Doctrine] Ammunition has no requirement at present to move ISO containers. Container is unstuffed where PLS meets the ISO container."
- "Could consideration be given to reducing size of HIK, especially for storage. Maybe a fold concept?"

Developmental Community

- "The HIK concept is totally consistent with container supply and resupply of the Light or Heavy Divisions."
- "The HIK could be used to clear containers during LOTS."
- "The HIK has merit and should be continued as an enhancement to PLS. The HIK components need to be as light as possible."

US TRANSCOM

- "The HIK has merit and the program should be continued. There is a need to find a way to carry the cruciform on the truck so it is available at all times."
- "Development of the HIK should absolutely be continued."
- "The HIK has merit and the program should be continued as a PLS enhancement, however, I think you should try to standardize the HIK rather

than have multiple ones." (Explanatory Note: The briefing indicated that conceptual designs were available for a light weight cruciform that would upload military shelters and lightly loaded containers, and an emergency ultra-light weight cruciform storable in the tool box of the truck for uploading commercial containers in an emergency when the normal cruciform was not available)

b. AMCON - 97% of the personnel answering the survey question pertaining to the AMCON, (38 of 39), agreed that the AMCON had merit. One questionnaire qualified the response in the same manner as the HIK comment above. A comment on a questionnaire from the OMMCS, (Office of the Munitions System Manager), stated that "DoD should not own strategic wholesale lift assets.[the military] should use off the shelf commercial containers." All others agreed that development of the AMCON should be continued. Other key comments are as follows:

Training and Doctrine Community

- "AMCON should also be considered for the movement of Class I, III, IV and IX items."
- "Needs/Requirements need to be identified and concepts developed."
- "The AMCON has merit. I am interested in the application of AMCON to the transport of Classes I, III, water and IX. It needs to be lighter."
- "The AMCON has merit. Many applications will be conceived as PLS is developed and fielded and Air Land Battle, Future concepts are developed."
- "AMCON should also be considered for use to transport of Classes II, III, IV, VII and VIII."
- "The AMCON should be tested in actual Division operations."
- "The AMCON is needed for intermodal shipments."
- "DoD should not own strategic wholesale lift assets. We should use off-the-shelf commerical [containers]."
- "We cannot afford PLS flat racks and AMCON - There is a need to concentrate on making PLS [flat rack] intermodal." (Explanatory Note: The briefing contained the statement that: "The present design of the AMCOM meets all current requirements for a PLS compatible intermodal flat rack.")

Developmental Community

- "The AMCON could meet the requirements of the 1077A1 with deltas to support the ROC of the future."
- "The AMCON can be used for general cargo as well as movement of ammunition."
- "UK and GE inoperability are very high on the priority list."
- "The AMCON program should be continued as an enhancement to PLS. It should be 8 ft or 8 ft 6 in high to allow use of present container load-out configurations."
- "Big plus [is the capability] to lower the ends."

US TRANSCOM

- "From a strategic mobility concept, the AMCON provides an end to end [wholesale to final user] 'box'."
- "The AMCON should be kept in favor of a PLS flat rack".
- "I fully agree the AMCON development program should be continued... It offers great flexibility."

2. Category "B" Conceptual Items, Future PLS Enhancements - Ten PLS enhancement conceptual items for which prototype hardware has not been fabricated were presented to determine user interest. Since one of these ten items, the Guide Roller Kit (GRK) had been funded and award of contract for the fabrication of GRK test prototypes was in process at the time of the survey, the question was asked: "Based on information presented at the briefing, does the GRK have merit and should the GRK effort be continued as a further enhancement to the capabilities of the PLS. All but one respondent answering this question, (38 out of 39), were in favor of fabrication and testing of the GRK. One questionnaire contained the statement: "The GRK has merit, but further review [information] is needed."

The survey participants were asked to prioritize the nine remaining PLS enhancement conceptual items with #1 being the item with highest merit for future development and number #9, having the least merit. Some of the questionnaires assigned the same priority to two or more items which was permissible based on the instructions provided. Others assigned priorities to some of the items but not to others. Table 1 is a list of the nine conceptual items arrayed across the top in descending order of priority with priority shown in the extreme left hand column. The numbers in the boxes represent the numbers of votes assigning that particular priority to the item.

(BLANK PAGE)

continued development should be dependent on the decision as to whether or not the use of the PLS would be expanded beyond that of only an ammunition carrier which is to be used forward of the Corps Support Area. Other key comments of interest are as follows:

Hq. DoD. TRANSCOM

- "The HIK has merit and the program should be continued. There is a need to find a way to carry the cruciform on the truck so it is available at all times." (Dep Dir Logistics, J3/J4)
- "Development of the HIK should absolutely be continued."(Log Plans Officer)
- "The HIK has merit and the program should be continued as a PLS enhancement, however, I think you should try to standardize the HIK rather than have multiple ones." (Chief, Log Policy) (Explanatory Note: The briefing indicated that conceptual designs were available for a light weight cruciform that would upload military shelters and lightly loaded containers, and an emergency ultra-light weight cruciform storable in the tool box of the truck for uploading commercial containers in an emergency when the normal cruciform was not available)

Hq. TRADOC

- "The HIK may be a good item to have if the Army expands use of the PLS beyond use for ammunition transport." (Transp. specialist)
- "Requirements/use needs to be [developed]/ evaluated. (TRASSO)

Logistics Center

- "The HIK has merit but it needs to be lighter."
- "The [HIK] system should be man handleable and meet road restrictions requirements. Requirements should be based on inter-intra theater requirements." (Major, Transportation Management Officer).

PM. Heavy Tactical Vehicles

- "The HIK concept is totally consistent with container supply and resupply of the Light or Heavy Divisions." (Project Manager)
- "The HIK could be used to clear containers during LOTS." (Mechanical Engineer)

Transportation School

• "The HIK is essential to carry shelters on the PLS. It is the only apparent answer to the [excessive] height problem when trying to move containers loaded on a flat rack ." (OR/SA Officer)

• "The PLS must be able to interface with commercial containers." (Log Mgmt Specialist)

Ordnance Missile and Munitions Center and School

• "The HIK development program should be continued. It can be used for movement of ISO type shelters.[Current Doctrine] Ammunition has no requirement at present to move ISO containers. Container is unstuffed where PLS meets the ISO container." (Log Mgmt Specialist, TRADOC MSM)

• "Could consideration be given to reducing size of HIK, especially for storage. Maybe a fold concept." (GS-12 Logistics Management Specialist)

Belvoir RD&E Center

• "The HIK has merit and should be continued as an enhancement to PLS - The HIK components need to be as light as possible." (GS-13 Principal Engineer).

b. AMCON - 97% of the personnel answering the survey question pertaining to the AMCON, (38 of 39), agreed that the AMCON had merit. One questionnaire qualified the response in the same manner as the HIK comment above. A comment on a questionnaire from the OMMCS, (Office of the Munitions System Manager), stated that "DoD should not own strategic wholesale lift assets.[the military] should use off the shelf commercial containers." All others agreed that development of the AMCON should be continued. Other key comments are as follows:

DoD, Hq, TRANSCOM

• "From a strategic mobility concept, the AMCON provides an end to end [wholesale to final user] 'box' ". (Chief, Jt. Log. Div)

• "The AMCON should be kept in favor of a PLS flat rack". (Log Plans Officer)

• "I fully agree the AMCON development program should be continued... It offers great flexibility." (Chief, Log Policy)

Hq. TRADOC

- "AMCON should also be considered for the movement of Class I, III, IV and IX items." (TRASSO)
- "Needs/Requirements need to be identified and concepts developed." (TRASSO)

Logistics Center

- "The AMCON has merit. I am interested in the application of AMCON to the transport of Classes I, III, water and IX. It needs to be lighter." (Deputy Commander)
- "The AMCON has merit. Many applications will be conceived as PLS is developed and fielded and Air Land Battle, Future concepts are developed." (GM-15)
- "AMCON should also be considered for use to transport of Classes II, III, IV, VII and VIII." (GS-12 Transportation Management Officer)
- "The AMCON should be tested in actual Division operations." (Transportation Management Officer).

Project Manager, Heavy Tactical Vehicles

- "The AMCON could meet the requirements of the 1077Al with deltas to support the ROC of the future." (Project Manager)
- "The AMCON can be used for general cargo as well as movement of ammunition." (Mechanical Engineer)
- "UK and GE inoperability are very high on the priority list." (Weapons System Manager)

Ordnance Missile and Munitions Center and School

- "The AMCON is needed for intermodal shipments." (MSG)
- "DoD should not own strategic wholesale lift assets. We should use off-the-shelf commerical [containers]." (TRADOC MSM, Log Mgmt Spec.)

Transportation School

- "We cannot afford PLS flat racks and AMCON - There is a need to concentrate on making PLS [flat rack] intermodal." (Log. Management Specialist) (Explanatory Note: The briefing contained the statement that: "The present design of the AMCOM meets all current requirements for a PLS compatible intermodal flat rack.")

Belvoir RD&E Center

- "The AMCON program should be continued as an enhancement to PLS. It should be 8 ft or 8 ft 6 in high to allow use of present container load-out configurations." (Principal Engineer)
- "Big plus [is the capability] to lower the ends." (Project Engineer)

2. Category "B" Conceptual Items. Future PLS Enhancements - Ten PLS enhancement conceptual items for which prototype hardware has not been fabricated were presented to determine user interest. Since one of these ten items, the Guide Roller Kit (GRK) had been funded and award of contract for the fabrication of GRK test prototypes was in process at the time of the survey, the question was asked: "Based on information presented at the briefing, does the GRK have merit and should the GRK effort be continued as a further enhancement to the capabilities of the PLS. All but one respondent answering this question, (38 out of 39), were in favor of fabrication and testing of the GRK. One questionnaire contained the statement: "The GRK has merit, but further review [information] is needed."

The survey participants were asked to prioritize the nine remaining PLS enhancement conceptual items with #1 being the item with highest merit for future development and number #9, having the least merit. Some of the questionnaires assigned the same priority to two or more items which was permissible based on the instructions provided. Others assigned priorities to some of the items but not to others. Table 1 is a list of the nine conceptual items arrayed across the top in descending order of priority with priority shown in the extreme left hand column. The numbers in the boxes represent the numbers of votes assigning that particular priority to the item.

Table 1. Priority of Development of Conceptual Items

(No. of Votes for each Priority)

PRIORITY	Lt. Wt. HIK	Open All Container	Liquid Transporter	MLRS Lashing System	Flat Rack Acft. Interface	MLRS Offloading System	Emergency HIK	HIK Semi-Trailer	Advanced Cargo Aircraft
1	11	16	6	7	4	2	1	2	0
2	16	8	6	4	3	4	3	5	1
3	11	2	6	3	7	3	3	0	0
4	3	2	4	6	2	5	2	3	3
5	5	4	1	4	4	3	6	2	1
6	0	4	4	3	0	4	4	2	2
7	0	0	3	1	5	0	3	9	3
8	1	0	1	0	8	1	4	0	6
9	1	2	2	2	1	1	1	3	8

In order to determine the relative ranking of each item, the votes were weighted as follows: Each priority 1 vote was assigned a weight of 9, each priority 2 vote a weight of 8, each priority 3 a weight of 7, etc.....each priority 9 a weight of 1. Table 2 portrays the weighted ranking of each item. The highest number representing the item considered to have the most merit for future development. The totals are shown at the base of each vertical column.

Table 2 Priority for Development of Conceptual Item by Agency

PRIORITY	Lt. Wt. HIK	Open All Container	Liquid Transporter	MLRS Lashing System	Flat Rack Acft. Interface	MLRS Offloading System	Emergency HIK	HIK Semi-Trailer	Advanced Cargo Aircraft
1	99	144	54	63	36	18	9	18	0
2	48	64	48	32	24	32	24	40	8
3	77	14	42	21	49	21	21	0	0
4	18	12	24	36	12	30	12	18	18
5	25	20	5	20	20	15	30	10	5
6	0	16	16	12	0	16	16	8	8
7	0	0	9	5	15	0	9	27	9
8	8	0	0	0	16	2	8	0	12
9	1	2	2	2	1	1	1	3	8
Total	276	272	202	191	173	135	130	124	68

Based on these data shown in Tables 1 and 2 it can be concluded that the order of merit for future development was viewed by those participating in the survey as follows:

1. Lightweight HIK
2. Open All Container
3. PLS Liquid Transporter
4. MLRS Lashing System
5. Flat Rack/Acft Interface
6. MLRS Off-loader
7. Emergency HIK
8. HIK Semi-Trailer
9. Advanced Cargo Acft.

During an informal IPR with the Government Project Officer for the purpose of reviewing the preliminary survey results, it was suggested that responses to a particular enhancement item by one agency would be of greater significance than the same response by another agency. For example, since the Quartermaster School has mission responsibility for the transport of POL and other liquids, a favorable comment on a PLS compatible liquid transporter by a representative of the QM School would be of greater significance than from another agency that has only a passive interest in the function. Based on the above, Table 3 portrays the survey results stratified by agency. The numbers on the top half of each box are the numbers of people, by agency, assigning a priority to each conceptual item. The numbers on the bottom half of the boxes represent the number of people assigning priority 1 through 5 to the particular item signifying the top 50% highest merit for future development. Totals are summarized at the bottom of each vertical column.

The top horizontal line representing Hq, TRADOC indicates that 8 of 10 people assigned either priority 1,2,3,4, or 5 to the Light Weight HIK. Seven of eight people assigned one of the first five priorities to the Open All Container, and 8 out of 9 assigned one of the first highest priorities to the MLRS lashing system.

Table 3. Priority for Development of Conceptual Item by Agency

AGENCY	1. Lt. Wt. HIK	2. Openall Container	3. MLRS Lashing Syst.	4. PLS POL Transp.	5. Aircraft Carrier	6. MLRS Offloader	7. Emerg. HIK	8. HIK Semi-Trailer	9. Advanced Cargo Acft.
HQ, TRADOC	10 / 8	8 / 7	9 / 8	10 / 5	9 / 3	9 / 6	9 / 6	6 / 4	7 / 1
HQ, Log Center & QM School	3 / 3	3 / 3	1 / 1	3 / 2	4 / 4	1 / 1	1 / 2	2 / 1	1 / 0
PM, Tact. Wheeled Vehicles	6 / 6	5 / 2	3 / 2	5 / 5	4 / 4	0 / 0	4 / 2	4 / 1	4 / 1
T.&A. Log. Schools	8 / 8	8 / 8	5 / 4	6 / 5	5 / 1	4 / 2	5 / 4	4 / 1	3 / 0
RD&E Center	6 / 6	6 / 6	5 / 5	4 / 3	5 / 3	4 / 3	3 / 1	6 / 3	4 / 1
Hq, DOD TRANSCOM	2 / 2	4 / 3	3 / 2	3 / 2	4 / 3	3 / 3	2 / 0	3 / 1	4 / 2
Ord. Msl. & Mun Ctr & School	2 / 3	4 / 3	2 / 2	2 / 1	3 / 2	2 / 2	2 / 1	1 / 1	1 / 0
TOTALS	37 / 36	38 / 32	28 / 24	33 / 23	34 / 20	23 / 17	26 / 16	26 / 12	24 / 15

ANALYSIS OF SURVEY RESULTS

1. The availability of prototype hardware, Level 1 design drawings and hard field trial data supporting the demonstrated proof of principal of the HIK, is believed to have contributed to the unanimous and enthusiastic agreement among all agencies briefed that the HIK will provide an enhanced capability to the PLS and development should therefore be continued.

The few statements which qualified agreement for continued development were based on the current doctrine that the PLS will operate only forward of the Corps Support Area (CSA).

2. The availability of prototype hardware, Level 1 design drawings and hard field trial data supporting the demonstrated proof of principal of the AMCON, contributed to the enthusiastic agreement among all agencies briefed that the AMCON provides an enhanced capability to the PLS and development should be continued. Concerns were expressed over whether or not the Army could afford both a PLS flatrack and an AMCON. The suggested solution seems to be to develop one flat rack or AMCON that is light as possible but still meets all intermodal requirements.

3. It is believed that the heavy support for fabrication and testing of the Guide Roller Kit was due to the apparent simplicity of design of the GRK coupled with the recognition that this kit would enable an operator of a PLS vehicle to offload a fully loaded PLS flatrack from M871/M872 type trailers in those areas in which the large overhead

cranes may not be readily available, thereby enhancing the operational capabilities of the PLS.

4. The suggested priority shown by respondents for development of future conceptual PLS enhancement subsystems/components in descending order of priority are:

a. Lightweight HIK
b. Open All Container (with varying functional configurations)
c. PLS Liquid Transporter
d. MLRS Lashing System
e. Flat Rack Aircraft Interface System
f. MLRS Offloading System
g. Emergency Ultra-lightweight HIK
h. HIK Semi-trailer
i. Advanced Cargo Aircraft/PLS Flat Rack Interface

5. Based on the interest shown by agencies visited, on the work underway/ planned by HEL in providing future enhancements to the PLS, there is a need to maintain a continuing dialogue and close working relationship between the materiel development and user communities in furtherance of the PLS Enhancement Program effort.

RECOMMENDATIONS

Based on the above results, it is recommended that:

1. The HIK and AMCON laboratory research and field trial programs be transitioned to an appropriate AMC development command for continued development as top priority PLS enhancement programs, pending preparation of appropriate user requirements documents.

2. Upon successful proof of principal type demonstrations, the Guide Roller Kit be similarly transitioned.

3. Concept design, prototype fabrication and field trials be initiated by HEL for the following PLS future enhancements in order of priority as listed:

a. Lightweight HIK
b. Open All Container (with varying functional configurations)
c. PLS Liquid Transporter
d. MLRS Lashing System

e. Flat Rack/Aircraft Interface Kit
f. MLRS Offloading System
g. Emergency HIK
h. HIK Semi-trailer
i. Advanced Cargo Aircraft/PLS flat Rack interface

2. A copy of this report be provided to the senior official of each of the nine agencies participating in this survey, the PM AMMOLOG and other interested agencies/activities.

3. A briefing containing the results of this survey be prepared and presented to the Commander, US Army Materiel Command (AMC) and Department of the Army, Deputy Chief of Staff for Logistics (DA, DCSLOG).

4. AMC/TRADOC charter a joint PLS Enhancement Working Group chaired by HEL with membership from appropriate AMC Major Subordinate Commands and TRADOC schools and combat development elements. The mission of this working group would be the continuing review and analysis of the HEL progress on PLS enhancement projects, and initiation of action on an "as required" basis to provide for the timely issuance of appropriate requirements documents on those PLS enhancements for which a requirement is visualized.

REFERENCES

ASI Systems International Report 90-01,"Hooklift Interface Kit (HIK) Phase II Design Field Test Results," D. J. Shearin, Sr., March 90.

ASI Systems International Report 90-02, "Phase II Design Intermodal Ammunition Container (AMCON) Field Test," D. J. Shearin, Sr., March 90.

Note: Copies of the above reports can be obtained from the U.S. Army Laboratory Command, ATTN: SLCHE-CS, Aberdeen Proving Ground, MD 21005-5001.

APPENDIX A

PLS ENHANCEMENTS SURVEY QUESTIONNAIRE

Name_____ Rank_____

Organization_____ Position Title_____

Telephone No. AV_____ Commercial (_____)_____

Proof of Principal Established (Please check if you agree)

1._____ The HIK had merit. The program should be continued as an enhancement to PLS.

Comments:_____

_____

2._____THE AMCON has merit. The program should be continued as an enhancement to PLS.

Comments:_____

_____

_____

3._____The Guide Roller Kit (GRK) has merit. The program should be continued as an enhancement to PLS.

Comments:_____

_____

_____

Conceptual

PLEASE PRIORITIZE THE FOLLOWING WITH #1 BEING THE HIGHEST MERIT FOR FUTURE DEVELOPMENT. IF YOU CONSIDER TWO OF MORE ITEMS OF EQUAL PRIORITY, GIVE THEM THE SAME NUMBER.

PRIORITY	ITEM	PRIORITY	ITEM
_____	MLRS LASHING SYSTEM	_____	PLS LIQUID TRANSPORT SYSTEM
_____	LIGHT WEIGHT HIK	_____	MLRS OFF LOAD FROM PLS
_____	EMERG. ULTRA LIGHT HIK	_____	FLATRACK/ACFT. INTERFACE
_____	HIK SEMI-TRAILER	___	ADVANCED CARGO ACFT
_____	"OPEN ALL" CONTAINER	_____	_____
			(Other)

(PLEASE USE REVERSE SIDE FOR ADDITIONAL COMMENTS)